PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Automatic Air Relief Device

I, AXEL NORE ALEXANDER AXLANDER, of Orrspelsvägen 16, Stocksund, Sweden, a Swedish Subject, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an automatic air relief device suitable for use in a liquid system, such as hot water piping, requiring the automatic discharge of unwanted air or other gaseous medium.

In order to obtain the highest efficiency in hot water heating installations, it is necessary that air pockets be removed from pipings, coils, etc. These pockets prevent circulation of the water and result either in less heat being available, or in excessive heating effect in certain parts of the installation. In those parts of the hot water system where the heat is reduced, the heater may be damaged by freezing. Such damage may cause long interruptions in working and be rather costly and difficult to repair.

In a hot water system, it is therefore of great importance that the air separated from the circulating water be removed by an air relief device. For this reason, the pipes carrying the circulating water are placed in position with a pitch so that the air may rise to certain high points in the system. These high points are generally furnished with air domes in which the air can accumulate without disturbing the water circulation. Such places are frequently equipped with manually operated air valves.

It will be readily appreciated that manual de-airing takes time, especially in large installations where the devices are spread over large areas. There is also the risk that one of the valves will be forgotten, with concomitant damage to the surrounding property.

Various forms of automatic air relief devices have been proposed and used heretofore, but these devices have not proved entirely reliable, either by not allowing the accumulated air to escape or by allowing water to escape with the air.

In most of these devices the movements of the float and the valve are small in magnitude. Coupled with this, the volume of air separated from the water is normally rather inconsiderable, and thus the valve operates with a very small opening and small movements. The small opening frequently fills with dirt, etc., so that the valve is apt to stick, making operation unreliable.

An automatic air relief device constructed in accordance with the present invention allows a certain volume of the air to escape, whereupon it closes completely. When the accumulated air has again reached a predetermined volume, the device opens fully and allows the air to escape. This cycle is repeated as required by local conditions. The valve thus operates intermittently and is kept open only for the time required to permit the accumulated air to escape from the device. The air relief device thus moves directly from fully opened to fully closed and *vice versa*. This arrangement prevents the device from sticking in a position between opened and closed positions.

The operation is obtained by an arrangement in which the float operating the relief valve does not actuate it during the greater part of the float movement. Only in the near-upper position of the float does it close the relief valve when the float is rising, and only in its near-lower position does the float open the relief valve as the float is sinking. When the valve is forced to close by the rising float, and the float thereafter sinks back due to the accumulating air, the valve is kept closed by the pressure in the pipes not only until the float has sunk to a certain limit, but until its weight has overcome the closing effect of the internal pressure on the air relief valve, which is then suddenly opened.

A better understanding of my invention may be had from the following description taken in conjunction with the accompanying

drawing, in which:—

Fig. 1 is a vertical sectional view of a preferred form of the new automatic air relief device;

Fig. 2 is a similar view of part of a modified form of the device;

Fig. 3 is a reduced perspective view of the device shown in Fig. 1; and

Fig. 4 is a reduced perspective view of the device shown in Fig. 2.

For purposes of illustration, the invention will be described in connection with a hot water installation, although it will be understood that it may be employed in any system requiring automatic exhaustion of air or other gaseous medium. Referring now to Figs. 1 and 3 of the drawing, the automatic air relief device there shown contains an enclosed float chamber 1. The volumetric capacity of this chamber is substantially defined by a hollow casing 2, and a bottom plate 3 secured to the casing by any suitable means, such as machine screws 4. As will be seen, casing 2 has an outer shape in the form of a truncated cone, the cone narrowing upward toward the top and terminating in an opening for receiving a valve housing 8. In the bottom plate 3 is an inlet port 5 internally threaded so as to enable the entire device to be mechanically secured to any pipe or other place from which air and liquid components are derived. For example, inlet port 5 may be connected to any point in a hot water installation from which it is desirable to remove accumulated air. In the region of the bottom of the casing is a strainer 6, the purpose of which is to prevent solid material from entering the float chamber proper from the inlet port 5. It is, of course, equally feasible to place the strainer 6 within the inlet port 5.

The housing 8 comprises a hollow cylindrical jacket having a perforated partition 9 forming the bottom of the housing, and a removable plug or lid member 12, the whole defining a cylindrical recess 7. The bottom 9 of the housing contains a central hole located between two holes 11, the latter holes being located equidistantly from the centre hole. The holes 11 provide communication between the chamber 1 and the recess 7 of the housing. A protruding flange on partition 9 fits under the shoulder forming the opening in the top of the casing 2, the protruding flange being held fast against the shoulder by means of a clamp ring 10 screwed on the cylindrical housing 8. The housing 8 contains an outlet passage communicating with the interior of the chamber 1, and outlet openings connected to this passage for providing a conduit from the passage to the ambient atmosphere. In the embodiment shown in Figs. 1 and 3, the outlet passage is a central bore 14 terminating at its lower end in a circular valve seat 13. The upper end of bore 14 includes an enlarged tapped hole, in the walls of which are drilled one or more outlet openings 14*a* for the outgoing air.

The operative parts of the valve are built around a valve stem 15 mounted for reciprocation within the central bore 14. The stem has a smaller diameter than that of the bore so as to permit the air components to escape therebetween, as shown in the drawing. Near the top portion of the stem is a guiding cone 16, the larger diameter of which is surrounded by a packing or closure member comprising a packing 17 enclosed in a holder 18. The purpose of the packing member is to seal the opening to passage 14, when the valve is in the closed position against the seat 13. The closure member 17, 18 is opened and closed by means comprising a pair of butting plates or flanges 19 and 21, and actuating projections 29. The two butting plates are spaced from each other on the valve stem, upper butting plate 19 being secured to a hub 20 and to the stem 15, while lower butting plate 21 is mounted on the stem by upsetting or enlarging the lower end of the stem. It will be noted that the lower butting plate 21 may thus be displaced vertically upward on the stem, while movement vertically downward is arrested by the enlarged bottom of the stem.

In the centre hole of partion 9 a depending protective tube 22 is secured in any suitable manner, the tube enclosing valve stem 15 with a clearance. The tube 22 extends down into the enclosed float chamber 1, as shown in the drawing, and is open at the bottom. Within the float chamber 1 is a hollow float 24 having two circular ends 25 and 26 and a central vertical tube 27. Tube 27 extends beyond the bottom end 26 so as to form a projection. Float 24 has the general configuration of a truncated cone. The annular interior space 23 of the float is hermetically sealed. The cavity 23 may contain a weighting medium to provide the most suitable weight for the float to satisfy local operating conditions. For example, cavity 23 may be filled with air, or partially filled with a suitable liquid, small lead shot, sand or a weight 28. The float is guided for vertical displacement on tube 22.

The top portion of the device is covered by a hood 30 having the general shape of a truncated cone fixed to the valve housing, as by means of a screw 31 positioned in the enlarged tapped hole formed in outlet passage 14. The outside of the hood forms a continuation of the outside of the hollow chamber casing 2. The bottom edge of hood 30 and the top of chamber 2 define a slot 32 for the outgoing gaseous component, as shown by the arrows in Fig. 1.

In the embodiment shown in Figs. 2 and 4, I employ a somewhat different arrange-

ment for use when the outgoing gas contains components which are either harmful or objectionable to those persons in the immediate proximity of the device. A fitting is screwed into the valve housing 8 so as to close the outlet openings 14*a*, while permitting communication with the outlet passage 14. The fitting comprises a hollow stud 36 and a surrounding collar 34 connecting the stud to a tube 33. The stud 36 is externally threaded so as to fit into the enlarged tapped hole in passage 14, and is provided with a shoulder for retaining hood 30 in position on the valve housing. The stud 36 is tightened against a gasket 35 positioned at the bottom of the enlarged tapped hole. The exhaust pipe or tube 33 communicates with the outlet passage 14 through the connection thus described.

The operation of the automatic air relief device is as follows. In order to facilitate explanation, let it be assumed that the inlet port 5 is connected to a pipe in a hot water installation, from which pipe it is desired to expel the accumulated air. The initial position of the device is shown in Fig. 1, with the chamber 1 empty. In this position, the float defines a "first position." The air in the system passes in through the inlet 5 and around float 24, enters holes 11, continues through air passage 14 and outlet openings 14*a*, and passes under hood 30 via slot 32 to the open air. When a sufficient volume of air has thus been released, the water starts pouring into the chamber 1 from inlet 5, and the float 24 begins to rise. At first, the valve stem 15 does not immediately move from the first position shown in Fig. 1. The float continues to rise until the actuating projections or pins 29 strike the under side of the upper butting plate 19. As the float continues to rise above this striking position, the vertical movement of the float is imparted to the valve stem 15 through plate 19. The extreme upper vertical displacement of the float is reached when the packing 17 is pressed against the seat 13, thus closing the outlet passage 14 and preventing further escape of the air. This position of the float is its "second position."

Since the air cannot now escape from the enclosed chamber 1, it accumulates in the upper portion of the chamber displacing water from the chamber through outlet 5. The float 24 now slowly sinks, but no movement is imparted to the valve stem 15 at this time. Outlet passage 14 remains closed, sealed by packing member 17, under the action of the air pressure within housing recess 7. As the float continues to sink further, the projecting bottom of tube 27 strikes against lower butting plate 21. The float is then held against further downward movement despite the continued fall of the water level within the chamber 1. However, as the water level falls lower and lower, the force of the weight 28 is increasingly felt upon the lower butting plate 21, until ultimately the downward force upon butting plate 21 overcomes the upward force of the air pressure against packing member 17, thus releasing it with a jerk from its sealing position on the valve seat 13. The valve stem 15 now drops rapidly until hub 20 strikes the top of partition 9, as shown in Fig. 1. The outlet passage is now open, and the air within the enclosed chamber 1 flows out through openings 14*a* to the ambient atmosphere, and the above described movements of the device begin anew.

It is important in automatic relief devices of the kind described that the valve should close at precisely the right moment, and that water splashing does not occur. It has been found empirically that water splashing can be avoided if the internal volume of the valve housing 8 is below a certain limit, as compared with the volume of air enclosed by the float chamber 1 on the closing of the valve. The placing of the valve housing above the chamber 1, and their partial separation by the perforated partition 9, also contribute toward preventing water splashing.

In those applications of the device where the water flows slowly into inlet port 5, the height of the float should be fixed by the level of the water surface, so that at a certain desired level the valve will close. However, this latter application will rarely, if ever, occur, since in practice, the water or other liquid component flows rapidly into the chamber under a velocity determined by the pressure in and the width of the space between the valve stem 15 and the walls of the outlet passage 14, and also the pressure drop caused by the strainer 6. The water has thus a certain motion and can produce a velocity head acting upwards when the water is flowing into the float chamber, both on the lower butting plate 21 and the lower float end 26. Also, when passing upward around the jacket of the float, the water by friction causes a lifting effect. By this velocity effect, the float and valve are lifted for closing sooner than they would be merely by the level of the water when rising slowly. The valve, as it were, closes somewhat too early. This means that, when the valve has closed, the float will immediately fall back somewhat. The friction between the butting pins 29 and the upper butting plate 19 ceases and the stem 15, with the attached devices, is not influenced by any other forces than the internal pressure in the valve housing and the float chamber. Without this effect, the butting pins would, after closing, rub against the upper butting plate and make closing unreliable.

In cases of a high water pressure, it may be useful to put a strainer in the fitting 5 and provide it with small openings. It will then

act as a throttling disc, preventing too pronounced an action due to the velocity of the water pouring into the float chamber 1.

Adjusting of the valve must be effected with regard to the static water pressure. If the tightening edge of the valve seat 13 defines a surface of a mm², and if the weight of the stem is g grams, the weight of the float G grams, and the pressure in the valve housing P metres water, then the weights g and G should comply with the conditions:

$$g = a \times P\,\text{min} \qquad G + g = a \times P\,\text{max}$$

From these equations, g and G can be calculated for the pressure limits within which the device can be used.

It is not necessary that the device be designed as a cylindrical body. The design could be made in many different ways within the scope of the invention. Neither need the float 23, as in the above example, act directly on the stem 15. Its force and motion may be transferred to the valve stem by means of levers or the like. The holes 11 in the bottom 9 of the valve housing may be replaced by some other equivalent means, and so may the butting pins 29. Many other modifications are possible within the scope of the invention.

What I claim is:—

1. An automatic air relief device for use in liquid systems with substantially constant pressure, which comprises a hollow member forming a float chamber, and having an inlet opening for admitting liquid and air into the chamber, the chamber having at its upper portion an outlet for exhausting air from the chamber, an air relief valve controlling flow through said outlet, a float in the chamber movable vertically relative to the valve, means for establishing an operating connection between the float and the valve in an upper position of the float and through which the valve is closed by upward movement of the float, means responsive to the air pressure in the chamber for holding the valve closed independently of the float, and means for establishing an operative connection between the float and the valve in a lower position of the float and through which the valve is opened against the action of the means holding the valve closed by downward movement of the float.

2. A device according to Claim 1, in which the means for holding the valve closed includes two surfaces of the valve which, in its closed position, are subjected to the differential pressures in the chamber and in the outlet beyond the valve, respectively.

3. A device according to Claim 1, in which the hollow member also forms a valve chamber overlying the float chamber and having a perforated partition through which the valve communicates with the float chamber.

4. A device according to Claim 1, in which the hollow member also forms a valve chamber overlying the float chamber and having a perforated partition through which the valve communicates with the float chamber, the volume of the valve chamber being not more than one-third of the air volume in the float chamber when the valve is closed.

5. A device according to Claim 1, comprising also a hood secured to the hollow member and forming a space to which said outlet leads, the hood also forming with the hollow member a slot for discharging air from said space.

6. A device according to Claim 1, in which the float chamber is in the form of a truncated cone narrowing upward toward the valve.

7. A device according to Claim 1, comprising also a hood secured to the hollow member and forming a space to which said outlet leads, the hood also forming with the hollow member a slot for discharging air from said space, the hood and the hollow member forming together a truncated cone.

8. A device according to Claim 1, in which said inlet opening is directed upwardly toward the float, whereby liquid entering the chamber through the inlet opening exerts a velocity pressure on the bottom of the float.

9. A device according to Claim 1, in which the side of the float and the interior wall of the hollow member define an annular space between the inlet opening and the valve, whereby friction of the liquid flowing from the inlet opening to the valve tends to lift the float.

10. A device according to Claim 1, in which said outlet is in the form of a passage having an air exhaust opening, and a removable hollow fitting closing the exhaust opening but communicating with the valve to conduct air away from the device.

11. An automatic air relief device for use in liquid systems, which comprises a hollow member forming a float chamber and having an inlet opening for admitting liquid and air into the chamber, the chamber having at its upper portion an outlet for exhausting air from the chamber, an air relief valve controlling flow through said outlet, the valve including a stem extending downward into the float chamber, spaced abutments on the stem, a float in the chamber movable relative to the stem but having a part engageable with one of the abutments, in an upper position of the float, to close the valve upon rising of the float, the valve being held in its closed position by the air pressure in the chamber, and a part on the float engageable with the other abutment, in a lower position of the float, to open the valve against said air pressure upon downward movement of the float.

12. A device according to Claim 11, in which the stem extends through the float, said abutments being located, respectively, above and below the float and spaced apart

sufficiently to allow vertical movement of the float relative to the stem.

13. A device according to Claim 11, in which the hollow member also forms a valve chamber and has a perforated partition separating the valve chamber and the float chamber, said first part on the float extending upward through the partition toward said first abutment.

14. A device according to Claim 11, in which the hollow member also forms a valve chamber and has a perforated partition separating the valve chamber and the float chamber, the valve stem extending downward through the partition.

15. A device according to Claim 11, in which the hollow member also forms a valve chamber and has a perforated partition separating the valve chamber and the float chamber, and a tube depending from the partition and surrounding the valve stem.

16. A device according to Claim 11, in which the hollow member also forms a valve chamber and has a perforated partition separating the valve chamber and the float chamber, a tube depending from the partition and surrounding the valve stem, and a central tube in the float surrounding and guided by the depending tube.

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705,897 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig.1

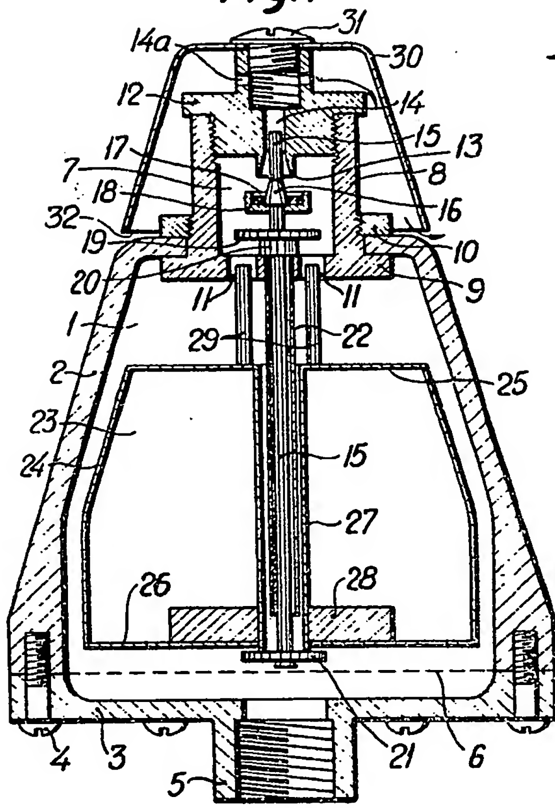

Fig.2

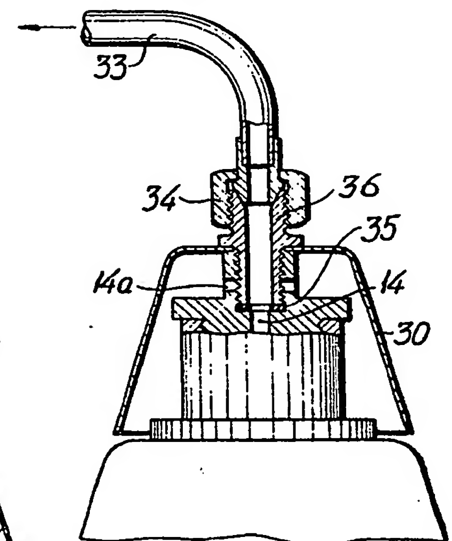

Fig.3

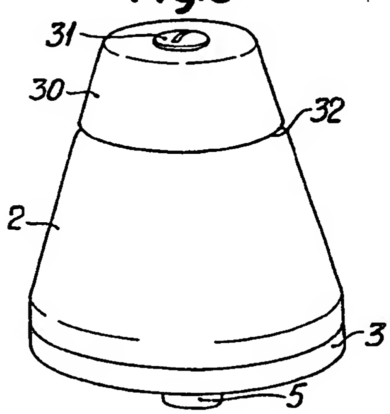

Fig.4